AUTOMATIC GREENHOUSE WATERING SYSTEM AND MONITORING

MOHAMMAD IZHAN BIN JAFRY

A thesis submitted in fulfillment of the
requirements for the award of the degree of
Electrical Engineering (Electronics)

Faculty of Electrical & Electronics Engineering
Universiti Malaysia Pahang

November 2007

I declare that this thesis entitled “AUTOMATIC GREENHOUSE WATERING SYSTEM AND MONITORING” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : _____

Author : MOHAMMAD IZHAN BIN JAFRY

Date : 17 NOVEMBER 2008

Special dedication to my parents especially my mother that always inspire, love and stand beside me, my supervisor, my fellow colleagues, and all FKEE lecturers and staffs.

ACKNOWLEDGEMENT

I would like to express my sincere thanks to my supervisor, Madam Nurulfadzilah bte Hasan for her patience, guidance and advice throughout the year, which proved valuable for the success of this thesis.

Also, I would like to thank my family, especially to my mother, Madam Jamilah bte Uti for her encouragement and financial support through all this year.

I have to thank the helpful staffs of FKEE, for giving me the permission to do the necessary research work and to use component needed. Furthermore thanks to Mr. Mohammad Fadhil bin Abas for his help and advice.

Not forgetting also, my friends, heartfelt thanks to all of them for their support and encouragement throughout the year. Their views and tips are useful indeed. Unfortunately, it is not possible to list all of them in this limited space. Without their continued support and interest, this thesis would not have been the same as presented here.

ABSTRACT

The primary issue of greenhouse based horticulture is to manage the greenhouse environment optimally in order to comply with the economic and environmental requirements. Pests and diseases, and extremes of heat and humidity, have to be controlled, and irrigation is necessary to provide water. The solution to these problems is by designing an automatic controlled system. Two sensors are used in this project. Soil moisture sensor needed to automatically control the valve of watering system. Temperature sensor will measure the condition of the greenhouse. Once the temperature sensor detect that the environment temperature is higher than the predetermined temperature value, the cooling fan will be in the on state and vice versa. Wireless monitoring using RF are used in order to monitor the condition of the greenhouse in the predetermine RF range. This project improved the irrigation system from manual to automatic to make it easier to monitor the condition of the greenhouse remotely.

ABSTRAK

Isu utama rumah hijau dalam pertanian adalah untuk mengurus keadaan rumah hijau sepenuhnya dalam memenuhi keperluan ekonomi dan persekitaran. Serangga perosak dan penyakit, suhu dan kelembapan yang keterlaluan hendaklan dikawal dan sistem pengairan adalah diperlukan untuk membekalkan air. Untuk mengatasi masalah ini adalah dengan mencipta satu system kawalan automatik. Dalam projek ini, dua sensor digunakan. Sensor kelembapan tanah diperlukan untuk mengawal injap sistem pengairan secara automatik. Sensor suhu akan meningkat keadaan suhu dalam rumah hijau. Apabila sensor suhu mengesan keadaan sekeliling lebih tinggi daripada suhu yang ditetapkan, kipas penyejuk akan dihidupkan atau sebaliknya. Pemantauan tanpa wayar dengan RF digunakan untuk mengawasi keadaan rumah hijau dalam lingkungan kawasan RF. Projek ini akan memperbaiki sistem pengairan daripada secara manual kepada automatik untuk memudahkan pengguna mengawasi keadaan rumah hijau dari jauh.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

RF	Radio Frequency
ADC	Analog Digital Converter
AC	Alternating Current
DC	Direct Current
GUI	Graphical User Interface
ADPU	Analog to digital power unit
CSEL	Clock select

LIST OF APPENDICES

APPENDIX TITLE PAGE

CHAPTER 1

INTRODUCTION

1.1 Background

A Greenhouse is a building with glass walls and roof; for the cultivation and exhibition of plants under controlled conditions. Greenhouses also are often used for growing flowers, vegetables, fruits, and tobacco plants. Pests and diseases, and extremes of heat and humidity, have to be controlled, and irrigation is necessary to provide water. Greenhouses protect crops from too much heat or cold, shield plants from dust storms and blizzards, and help to keep out pests. Light and temperature control allows greenhouses to become suitable place for growing plants. In other word, a greenhouse is a structure that provides protection and a controlled environment for raising plan indoors. The primary issue of greenhouse based horticulture is to manage the greenhouse environment optimally in order to comply with the economic and environmental requirements.

1.2 Objectives

The objective of this project is to implement automatic greenhouse watering system based on soil moisture sensor and wireless based system monitoring.

1.3 Scope

Several scopes that need to be considered in this project:

i. Sensor used to control the watering system is soil moisture sensor.
ii. Fan system control based on temperature sensor is used as greenhouse temperature controller.
iii. The condition of the Sensors & outputs are to be monitor with remote display based on wireless module.

1.4 Problem Statement

Irrigation is the important thing on a greenhouse system. The water we provide, which is the main element, will make sure the plants survive on certain circumstances. As we all know, most of the gardener use the manual system to irrigate their plant but this system is not efficient. The plants will either die if there is not enough water supply to the plant or vice versa. Plus the gardener must often monitor their greenhouse to ensure the conditions of their plant are in the good health.

In order to maintain the condition and overcome the problem, the automatic watering system and remote monitoring is used. This will reduce the time if using automatic rather than manual way of watering. Fewer workers are needed to maintain the plants or crops. The sensors such as temperature sensor and soil moisture detector are used to control the temperature and watering in the greenhouse.

The system also has the capacity to monitor the condition of greenhouse remotely from computer by using wireless module. The information will be transmitted by using radio frequency and the data will display using third party software such as visual basic. So user will know the condition of their greenhouse without going to the site and get the information.

1.5 Methodology

In order to achieve the objective of the scope few tasks need to be done for the hardware of the system and the GUI application software. For the hardware of the system there are four parts which have to be considered. They are the microcontroller board, the transmitter circuit and the receiver circuit. First of all, in this system, both of the microcontrollers have to be test and check for it functionality. It is to make sure that the microcontroller later can be initialized and the proper program can be burn into its EEPROM to do the appropriate task.

Secondly, transmitter and the receiver module need to be test for its functionality. It can be done by sending a bit of data from the transmitter to the receiver. The push button and the LED can be used as the representation of data sending and receiving. After that, the circuit can be integrating with both microcontroller and then the connection can be done.

Finally, the MAX233 is needed to test for its functionality. It is to make sure that the data can be serially send and receive through MAX233 to the microcontroller of the system. It can be made by downloading program of assembly language into the EEPROM of the microcontroller.

For the software of the system, there are two parts which have to be considered. They are the assembly language programming and the Visual Basic programming for GUI application. For the assembly language, the coding needed to be testing on the THRSim simulator software. The purpose of this simulator program is to debug errors. The Visual Basic 6 software used to make a connection to the remote monitoring using

GUI application. Hyper terminal is used to record data that have been received through the serial connection.

The last part in order to achieve the objective is to test the output of the system. The driver circuits which consist of relay and transistor are needed to be tested so that the cooling fan and the irrigation valve are functional. To test the relay is by giving appropriate power supply to its coil.

1.6 Thesis Outline

Chapter 1 discuss on the background of the project, objectives, scope of the project, problem statement, methodology and also the thesis outline.

Chapter 2 focuses on literature reviews of this project based on journals and other references.

Chapter 3 mainly discuss on the system design of the project. Details on the progress of the project are explained in this chapter.

Chapter 4 presents the results of the project. The discussion focused on the result based on the experiment.

Chapter 5 concludes overall about the project. Future recommendations and commercialization are also discussed in this chapter.

CHAPTER 2

LITERTURE REVIEW

2.0 Greenhouse

The development of models and strategies to control the environment of greenhouse crops started with the shoot environment, that is, with the greenhouse climate. One important reason was that influencing variables such as temperature, humidity, irradiation or CO2 concentration are easier to measure and to control.
[1Hans Peter Klaring, 2000]

From this research, we can see that there are a few factors that need to be control in a greenhouse. Those factors that need to be considered are temperature, humidity, irradiation or carbon dioxide concentration. But, in this project, factors that are going to be considered are only the temperature and soil humidity in a greenhouse.

2.1 Microcontroller

A microcontroller is a computer-on-a-chip. It is a type of microprocessor emphasizing high integration, low power consumption, self-sufficiency and cost-effectiveness, in contrast to a general-purpose microprocessor.

Microcontrollers are frequently used in automatically controlled products and devices, such as automobile engine control systems, remote controls, office machines, appliances, power tools, and toys.
[From Wikipedia]

By reducing the size, cost, and power consumption compared to a design using a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to electronically control many more processes.

2.2 Sensors

A sensor is a device which measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument.
[From Wikipedia]

Because sensors are a type of transducer, they change one form of energy into another. For this reason, sensors can be classified according to the type of energy transfer that they detect. Soil moisture measurements provide useful information for agriculture, such as grape growers, soil stability monitoring, dam monitoring and construction activities.
[R. Frank, 2000]

A typical greenhouse contains several sensors form measuring humidity, temperature, pressure, carbon dioxide, light, motion, etc, and contains several actors, such as, air conditioners, floodlights, sprinkler and water management facility, plant decks, air blowers, fans, CO2 production units, etc. In this project will only consider the temperature and the soil moisture of the greenhouse. There are many types of soil moisture sensor such as tensiometer, resistance block capacitive and etc. every types have their own characteristics and system operation.

2.2.1 Gypsum Blocks soil moisture sensor

Gypsum blocks are one of the lowest cost soil moisture monitoring products available. Their low cost and ease of interpretation makes them ideal for seasonal crops A block of gypsum placed in the soil will wet up and dry out at close to the rate of soil. When gypsum is wet it conducts electricity easily (it is low resistance), and when dry is a poor conductor (high resistance). A pair of electrodes within the block measures this change in resistance and a once off calibration equates it to soil moisture tension. It is possible to measure the resistance of the soil directly using a pair of electrodes, but the measurement would also be influenced by changes in the soil conductivity brought about by the presence of salt and other materials. The gypsum ions provides a buffer against

the impact of salt and nutrients – effectively preventing the salt ions from reaching the electrodes – and ensuring the sensor is only responding to moisture levels.

2.2.2 Temperature sensor LM35

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.
[National Semiconductor]

2.3 Wireless Data Communication

Wireless sensor data monitoring is much less labor intensive than periodic sampling by workers for most applications. Updates need be done only infrequently (e.g. daily), and only with moderate accuracy, but monitoring is often needed over a wide area and for long periods.
[Darold C. Wobschall]

This project consist transmitter and receiver to transfer data in order to monitor the greenhouse remotely. Both module are connected to the encoder and decoder also microcontroller. Radio is the wireless transmission of signals, by modulation of electromagnetic waves with frequencies below those of visible light. Electromagnetic radiation travels by means of oscillating electromagnetic fields that pass through the air

and the vacuum of space. It does not require a medium of transport. Information is carried by systematically changing (modulating) some property of the radiated waves, such as their amplitude or their frequency. When radio waves pass an electrical conductor, the oscillating fields induce an alternating current in the conductor. This can be detected and transformed into sound or other signals that carry information.

2.4 Valve

Solenoid valves are electromechanical valves that are controlled by stopping or running an electrical current through a solenoid, in order to change the state of the valve. A solenoid is a coil of wire that is magnetized when electricity runs through it. The solenoid valve makes use of this solenoid in order to activate a valve, thus controlling water flow, airflow and other things with electricity.
[Jimmy Sturo, 2006]

There are many applications using valve especially for the electrical devices. By using electromagnetic, valve is automatically energize and doing its job according to the application system. The function is as replacing the conversional valve, which does need user to operate the system. It is lot easier and more reliable.

2.5 Graphical User Interface GUI

A graphical user interface (GUI) is a type of user interface which allows people to interact with electronic devices like computers, hand-held devices (MP3 Players, Portable Media Players, Gaming devices), household appliances and office equipment. A GUI offers graphical icons, and visual indicators as opposed to text-based interfaces, typed command labels or text navigation to fully represent the information and actions available to a user. The actions are usually performed through direct manipulation of the graphical elements.
[Wikipedia]

By using GUI application it is more useful and user friendly. With interpretation of graphical technique it is easy to understand and lot more easily to control and manipulate the interface.